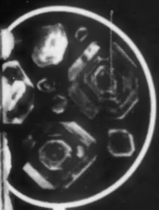
CHEMISTRY



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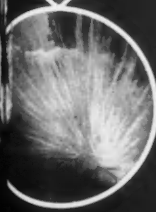

NOBEL

50¢

A SCIENCE SERVICE PUBLICATION

Chemistry and Biology

According to the classical definition of biology, it is the study of life or living organisms. This has proven to be such a large area that it has been necessary to divide and to subdivide the subject matter in order to provide adequate coverage of all areas.

We no longer speak of biologists but of zoologists, bacteriologists, botanists, physiologists, etc. Biology has become too large a field for one man to be an expert on the whole subject. It is necessary for one man to select a small segment for specialization.

As the knowledge of living organisms has developed the techniques of chemistry have been found to be very helpful. The important advances in all areas of biology are made by the application of chemistry to biological problems. Biochemistry is a new science that has developed because of the overlapping of chemistry into the field of biology.

It is not difficult to find many areas in biology where chemistry is contributing to the solution of important problems. The simple plant or animal cell is recognized as an enormously complicated chemical plant carrying out chemical reactions on the micro scale. The only way that we shall ever understand living organisms is through a knowledge of their chemistry.

One of the most fascinating stories in scientific research today is the unfolding of the mystery of photosynthesis. All of the tools of chemical research have been directed toward clarifying the process by which green plants convert carbon dioxide and water into glucose and oxygen.

Radioactive atoms, isotopes, chromatography, mass spectrography, and many others have contributed information that enables the researcher to piece the puzzle together. The story has not been completed yet but it is apparent that the chemist is playing an important role in its telling.

CHEMISTRY

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Including The Science Leaflet

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NOBEL CHEMISTRY AWARD

Nobel Winner Developed Accurate Dating Method

➤ THE FIRST accurate method for dating ancient objects won the 1960 Nobel Prize in Chemistry for Dr. Willard F. Libby, professor of chemistry at the University of California, Los Angeles.

Dr. Libby, a former Atomic Energy Commissioner, invented the method of using radioactive carbon-14 to determine the age of plant and animal remains as old as 25,000 years. He recognized that since radioactive atoms break up at a constant rate, they could be used as an atomic clock.

In 1947, Dr. Libby demonstrated that cosmic rays were converting nitrogen in the upper atmosphere to carbon-14. Carbon dioxide in the atmosphere contains a very constant proportion of carbon-14. Since plants use carbon dioxide to build their chemical constituents and in turn serve as food for animals, carbon-14 is present in all living animals and plants in a known quantity.

After the death of a plant or an animal, the amount of carbon-14 decreases as the radioactive decomposition proceeds. One-half of the radioactive carbon disintegrates in approximately 5,600 years. By measuring the amount of radioactive carbon in any object derived from plants or animals, its age can be calculated. This method gives an accurate determination of the age of archaeological and geological objects, which previously could only be guessed.

Dr. Libby also is known for his development of the use of tritium, the radioactive isotope of hydrogen, as a tracer for studying water in various meteorological and geophysical processes. He was the first chemist to be a member of the Atomic Energy Commission, serving from 1954 to 1959.

Physics: NOBEL PRIZE FOR BUBBLE TRAIL .... (See Page 2)

Medicine: NOBEL PRIZE FOR ARTIFICIAL IMMUNITY (See Page 2)

Trail of Bubbles Tells Tale of Atomic Particles

➤ A TRAIL of bubbles that tells the tale of atomic particles is the idea for which Dr. Donald A. Glaser of the University of California, Berkeley, won the 1960 Nobel Prize in Physics.

Dr. Glaser conceived the idea that the bubbles in a liquid could be photographed to show the fleeting tracks of atomic particles. He perfected a radiation detector, the bubble chamber, based on this idea in 1954.

The bubble chamber made possible the mass production of simple photographs showing what happens in atomic collisions. Bubble chambers filled with various liquids are placed in the beams of atomic "bullets" from virtually every atom-smashing machine in the world.

From the bubble chamber and other photographs of atomic collisions, scientists are learning more about structure of the atom and how it is held together.

Until invention of the bubble chamber, scientists had only two ways of seeing and measuring the debris from atomic collisions. One was the cloud chamber, the other photographic emulsions.

Dr. Glaser began work on the new approach that ended in the bubble chamber in 1952.

"It occurred to me," he said, "that a superheated liquid, like a supersaturated vapor, might provide a medium that could be triggered by a small stimulus to yield a very large effect.

"Chemists already knew that a very pure liquid may be heated above its usual boiling point without boiling. A bit of broken glass thrown into such a liquid will cause it to erupt in violent boiling.

"I wondered whether a flying atomic particle might, under suitable conditions, trigger microscopic bubbles that start the boiling process. If so, they might make a visible track which could be recorded by means of high-speed photography.

"I made a simple test. The technique worked!

Nobel Medical Award For Immunology Discovery

➤ THE DISCOVERY of artificial immunity by the two scientists who were awarded the 1960 Nobel Prize for Medicine may make possible the safe transplant of human organs.

Human implications of their research also include the role played by the grandmother in determining her grandchildren's Rh positive and negative blood factors.

Sir Frank Macfarlane Burnet, director of the Walter and Eliza Hall Institute for Medical Research, Melbourne, Australia, and Peter Brian Medawar, Jodrell professor of zoology, University College, London, share the 1960 Nobel Prize money, equal to $43,625.

Dr. Burnet was knighted in 1951 for his research in virus diseases. In 1949 he started other work, however, which was the basis for the joint Nobel award.

Sir Macfarlane's theory of antibody production is based on his observation of the involuntary behavior of the fetus and newborn animal in the selection of antigens, substances causing the formation of antibodies. Any foreign material then entering the animal at a later stage after birth would cause the formation of antibodies which would reject the foreign matter.

On the basis of Sir Macfarlane's work, Dr. Medawar tried injecting fetal or newborn mice with material from a donor mouse on the theory that the injected mice would consider this as native material. Later on, a graft from the same donor or of the inbred strain of mice showed acquired immune tolerance to the foreign tissue antigen.

Dr. Sanford H. Stone of the laboratory of immunology, National Institutes of Health, said, "The discovery opens the door to vast research.

"Since we know the fetal animal has a stage of immunological inactivity to make him tolerant so that he will accept a graft after birth, it might be possible to recreate the physiological conditions of infancy in an adult and perhaps develop a drug that can produce artificial tolerance."

This might make organ transplants possible some day in humans.

Dr. Medawar, under a grant from the National Institutes of Health, is studying the chemical nature of the antigens involved in graft rejections.

Safety Radiation Experts

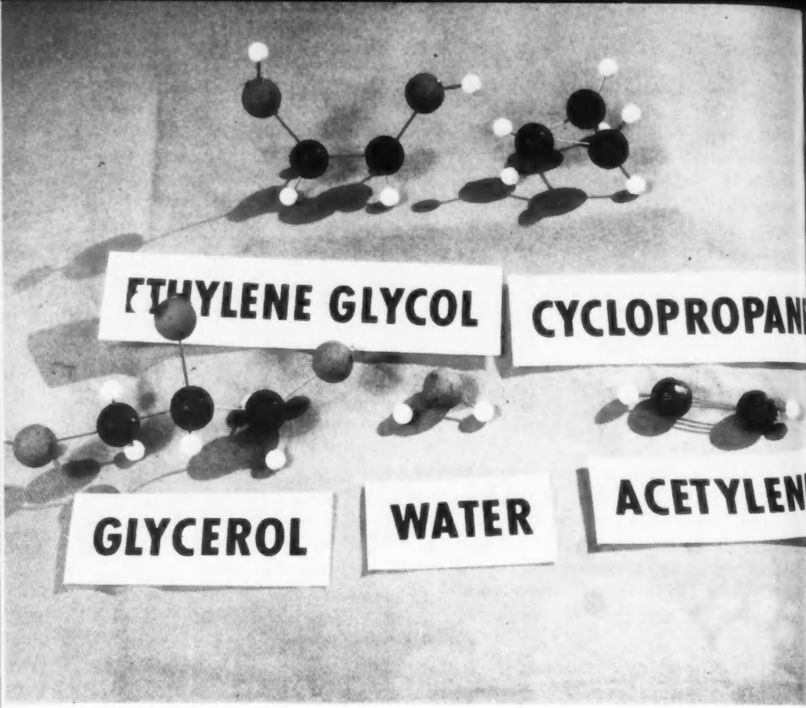
➤ A SERIOUS deficit exists in the number of experts being trained to cope with public health and safety problems accompanying the rapidly expanding use of radiation of various kinds in the United States.

Surgeon General Leroy E. Burney of the Public Health Service has warned that by 1970 at least 4,000 additional physicians, engineers and physicists trained in radiological health and protection measures will be needed.

This means that colleges and universities should be admitting at least 600 candidates annually for such training instead of the 200 now being trained each year.

The Surgeon General said that nearly half of the 4,000 additional experts needed would be employed by industry as it expands its use of nuclear power, of X-rays and isotopes.

Others will be needed in health agencies, hospitals, universities and research organizations.



➤ FIVE EXAMPLES *of the molecules that can be from the Chemical Models Unit, No. 240 are shown. Well over a hundred different molecules can be modeled in addition to the structure of the three isotopes of hydrogen and the two isotopes of helium.*

Make Your Own Models of Chemical Compounds

➤ MODELS OF ATOMS and molecules can be made from the current experimental unit, THINGS of science.

The kit contains materials representing protons, neutrons, electrons, carbon atoms, oxygen atoms and hydrogen atoms. Instructions tell how to build five models of atoms and more than 100 models of molecules of chemical compounds.

With this unit the three isotopes of hydrogen and the two isotopes of helium can be modeled.

The Chemical Models unit (No. 240) is available for 75¢ each or three for $1.50 by writing to THINGS of science, Science Service, 1719 N St., N.W., Washington 6, D. C. Membership in THINGS of science is available at $5.00 for 12 monthly units.

World's Biggest Accelerator

The most powerful accelerator of nuclear particles in the world is the atom smasher now operating at 28 billion electron volts in Geneva, Switzerland, under direction of the CERN organization of 13 European nations. This winter the U. S. will have a machine that gives particles energies of 30 billion electron volts. However, the cosmic rays accelerated in space and continuously smashing into the earth's atmosphere outclass the most energetic man-made accelerators.

by Ann Ewing

➤ Today, the world's most powerful atom smasher is the 28-billion-electron-volt machine now operating under the CERN organization of 13 European nations at Geneva, Switzerland.

This summer, however, the United States began experiments at even higher energies with the 30-billion-electron-volt accelerator at Brookhaven National Laboratory.

With the CERN and Brookhaven particle accelerators, plus many others now under construction, scientists expect to learn new facts about the atom and its nucleus. The protons or electrons, given terrific speeds by the accelerator, are used as "bullets" to crash into atoms. The particles that come flying out tell scientists about atomic structure. To some extent, this can be done by studying the tracks of atomic collisions caused by cosmic rays.

In space, the cosmic rays that continuously bombard the earth's atmosphere are accelerated to much higher energies than those available from any man-made machine now in operation or being built.

However, it is much easier to trace what occurs when atomic cores disintegrate if the collisions are produced in the known conditions of atom smashers.

Accelerators are used as "microscopes" to help scientists "see" inside the atomic nucleus, where distances are measured in fractions of a trillionth of an inch. The greater the energy of accelerated particles, the easier it is for scientists to "see" the detailed structure of the nucleus.

By studying the results of atomic smash-ups in high energy accelerators, scientists have found that the structure of atomic nuclei is not as simple as was once thought. Some 32 "elementary" particles are now known, and about half of these are anti-matter, a state opposite to that of ordinary matter. When an anti-proton and a proton collide, for instance, both particles are annihilated and matter is turned into energy.

Naturally radioactive materials, such as radium, were first used to bombard atoms and thereby learn more about how atoms are constructed. The energies involved in these early studies were only a few thousand electron volts.

The first man-made accelerators gave the particles less energy than

that of natural radiation, but paved the way for more powerful ones. The first in the billion-volt range were constructed during the early 1950's in the U. S.

Until the CERN machine reached energies of some 24 billion electron volts, usually abbreviated to Bev, late in 1959, the Russians were operating the world's most powerful machine, a 10-Bev accelerator at Dubna, Russia. The USSR several years ago announced plans for building a 50-Bev proton synchrotron, but little definite information on its progress has been released since then.

Basically, all accelerators consist of a source of particles, usually protons or electrons, to be accelerated, and a high vacuum chamber in which the particles can move without colliding too frequently with air molecules. Acceleration is achieved by giving the particles successive electric "kicks," and they are kept in position to receive these jolts by magnetic fields.

Atom Smashers

Atom smashers are broadly subdivided into two classes, linear and circular. Both the CERN and Brookhaven proton accelerators are circular and use the so-called strong focusing method to keep particles on their assigned paths.

Linear atom smashers are often used as pre-accelerators for the very large synchrotrons, as well as on their own.

The most ambitious plan for a linear accelerator involves building one two miles long at Stanford University, Calif. Congress has before it a request to authorize design and construction of such a high-energy electron accelerator.

It would be a "big brother" to the Mark III linear machine that has been successfully operated at Stanford with energies as high as 730 thousand electron volts. The Mark III is now being extended from 220 feet to 310 feet to allow operation at about 1.2 Bev.

The proposed two-mile accelerator would provide a ten-Bev electron beam, with an intensity some 50 times greater than that available from a circular electron machine.

Two U. S. circular accelerators currently in operation at Cornell University, Ithaca, N. Y., and California Institute of Technology impart to electrons energies of up to 1.5 Bev. The Russian newspaper Pravda recently announced that a four-Bev linear accelerator for electrons was under construction at Kharkov. A one-Bev circular machine is in the design stage in Russia.

When it is completed later this year, the six-Bev synchrotron being built jointly by Harvard University and Massachusetts Institute of Technology will be the most powerful electron accelerator in the world. The energy available for reactions with six-Bev electrons is the same as for 9.5-Bev protons, so that large numbers of the strange particles inhabiting atomic nuclei are expected to be produced in this machine, despite the fact that electrons are much weaker in their interactions with matter than are protons.

For accelerating protons, the U. S. now has two large machines in operation, a three-Bev synchrotron known as the cosmotron at Brookhaven National Laboratory and a 6.2-Bev synchrotron called the bevatron at the University of California's Lawrence Radiation Laboratory in Berkeley.

Two More

Besides the 30-Bev Brookhaven machine, two other large ones are under construction in the U. S.

One, a joint venture of Princeton University and the University of Pennsylvania, will be a three-Bev proton synchrotron. It is scheduled for completion by the end of 1960. Although similar to the cosmotron, it is designed to provide a much higher number of protrons per second in its beam, thus making possible experiments on nuclear events that otherwise occur too rarely for successful study.

The second is a 12.5-Bev proton accelerator under construction at Argonne National Laboratory, Lemont, Ill. It is scheduled for completion in 1962.

The Soviet Union has scheduled a seven-Bev proton synchrotron for operation in 1960.

From this summary it can be seen that the U. S. will have the largest and most sophisticated atom smashers of the world in operation by the end of this year.

It is noteworthy, however, that the 13 nations forming CERN are also building rather large machines on their own. The 13 nations are Austria, Belgium, Denmark, France, West Germany, Greece, Italy, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom and Yugoslavia.

In the United Kingdom, a seven-Bev proton synchrotron is under construction by several British universities. In France, a three-Bev proton accelerator was placed in operation in 1958 and a one-Bev linear accelerator is nearing completion. In Italy, a 1.2-Bev electron accelerator began operation in 1959. Australia and the Netherlands are building proton synchrotrons. Electron accelerators are under construction in West Germany, Japan and Sweden.

On the Back Cover

➤ THE BACK COVER *shows the large pressure vessel for the new "H-Iron" plant of Bethlehem Steel Company being erected into position at Los Angeles site by two cranes. First of its kind on the West Coast, the experimental "H-Iron" installation will employ a process developed by Hydrocarbon Research, Inc., in cooperation with Bethlehem to convert iron ore into iron by direct reduction with hydrogen. Reduction will take place in fluid bed inside this giant reducer under high operating pressures. Towering $122\frac{1}{2}$ feet, the big welded vessel is made of $2\frac{1}{8}$-inch thick chromemolybdenum shell plate to withstand the tremendous pressures. Typical plant to produce iron by the new process costs only about half as much as a combined coke oven and blast furnace operation, according to Hydrocarbon Research. Bethlehem will charge the iron produced in its new plant to electric furnaces to make steel.*

American Chemical Society Dedicates New Building

➤ Chemistry students must have closer contact with the frontiers of research, the chemical industry must open up larger world markets, and the United States must create an atmosphere that will make basic science flourish, the American Chemical Society was told as it dedicated its new three-million-dollar national headquarters in Washington, D. C.

These requirements for the coming era in American chemistry were laid down by three outstanding American chemists in a symposium on "Chemistry In Our Time" under the chairmanship of Dr. Wallace R. Brode, a director of the Society and chairman of its building committee.

Seaborg

Dr. Glenn T. Seaborg — chancellor of the University of California at Berkeley, Nobel Prize-winning chemist, and the codiscoverer of plutonium and seven other man-made elements — spoke for education. He deplored the present lack of communication between teachers and professional scientists, but pointed to many examples of rapid changes for the better.

Noyes

Professor W. Albert Noyes Jr. of the University of Rochester, editor of the *Journal of the American Chemical Society* and president of the International Union of Pure and Applied Chemistry, emphasized the vital importance of research in pure chemistry and stressed the necessity for a national attitude conducive to originality and productivity.

"We must give our children strong desires for the intellectual life whether it be in science, in arts, or in literature," he said. "The very bright and original youngsters must be sent to the best secondary schools, even if they must leave home to do so, and from there they should go to the best colleges and graduate schools."

Thomas

Dr. Charles Allen Thomas—chairman of the board of directors of the Monsanto Chemical Company, St. Louis, and former president and board chairman of the American Chemical Society — pointed out that the success of the American chemical industry has not gone unnoticed in other parts of the world.

"As we move into a new era of world economic competition and into the new phase of chemistry which is opening before us, it will be up to individual professional chemists to see if we can do as well in the future," Dr. Thomas told the symposium, adding,

"The same principles which have built the American Chemical Society can help us chart our future course."

Dr. Seaborg observed that "Since World War II there has been a very pronounced shift of the American industrial economy into the sophisticated engineering exploitation of advanced scientific knowledge. "This shift shows every sign of increasing at an accelerating rate.

"Today the person who wishes to

understand the industrial world, or to provide technical or managerial leadership of real significance to this industrial world, must have a mastery of scientific principles far greater than was required in the past.

"The changes also strongly affect the common man in the working force because the tools he uses and the tasks he is called upon to perform require more knowledge of mathematics and rudimentary scientific principles than was true before. In 1900 thirty percent of the U. S. work force was unskilled labor, while now the percentage is much less than ten.

"At the same time that these shifts in industrial practices have occurred, we Americans have entered an era in which we are thrust to a central place on the world stage and in which every aspect of our daily lives is influenced by and serves to influence what happens in every part of the planet.

"Science and technology play a huge role in the factors which shape the political and economic developments in all areas of the world. Scientific and technological knowledge will be called upon to aid in the solution, if any can be found, for many of these very serious problems.

"Fateful events of the past few years have created a growing awareness of the crucial importance of education for national survival and have stimulated an unprecedented re-examination of the entire school system with particular concern for science instruction.

Teaching of Chemistry

"I think it would be appropriate on this occasion to review some of the things which have been happening because of this re-examination. Since we here today are chemists and since chemistry is rated rightly as one of the key scientific disciplines, I shall restrict my remarks to current proposed changes in the teaching of chemistry.

"I shall start with the high school, since for many reasons, deficiencies in chemical education have been most serious at this level. The American Chemical Society, since its founding, has always had an interest in high school chemistry. One instance of this, among dozens I could cite, was the formation of a study committee established in 1959 to examine high school chemistry courses with the view to the production of a drastically improved course. Partly as a result of the recommendations of this committee the National Science Foundation decided to sponsor two detailed studies of the high school chemistry course. The earlier of these bears the name of the Chemical Bond Approach and is under the direction of Professor Lawrence E. Strong of Earlham College in Richmond, Indiana.

Chem Study

"The second is called the Chemical Education Material Study and is under my general chairmanship and under the directorship of Professor J. Arthur Campbell of Harvey Mudd College in Claremont, California. These two studies are part of a series of high school projects sponsored by the National Science Foundation.

"I should like to use the Chemical Education Materials Study as an example of the type of action contributing to a change. This is no more important than many other efforts, but just happens to be the one with which I am most familiar.

"The Steering Committee of this Study includes many of the most illustrious chemists in the profession. A preliminary meeting was held in Berkeley, California, in January of this year. The important decision was made to attempt the production of a high school chemistry text and accompanying laboratory experiments in time for trial use in a few high schools during the academic year 1960-61. This was admittedly an almost impossibly short time scale, but we felt that it was worth attempting in order to save a year in attainment of the ultimate objective.

"The general objectives of the Study are to develop new teaching materials for the high school chemistry course, including a textbook, laboratory experiments, a laboratory manual, films and supplementary reading materials. The more specific objectives will be to diminish the current separation between scientists and teachers in the understanding of science, to stimulate and prepare those high school students whose purpose it is to continue the study of science as a profession, to encourage teachers to undertake further study of chemistry courses that are geared to keep pace with advancing scientific frontiers, and to further in those students who will not continue the study of chemistry after high school an understanding of the importance of science in current and future human activities.

Writing Session

"A group of contributors consisting of nine college and university professors, and nine high school teachers was assembled for a six week writing session during the early part of this summer. The laboratory experiments were developed concurrently. A group of fourteen teachers from the San Francisco Bay Area and nine teachers from the Southern California area are now prepared to try out the new chemistry courses in their high schools during the coming school year.

"There will be weekly meetings in each of the two areas with staff members of the Chemical Education Material Study in order to monitor progress and continue to help the teacher to familiarize himself with the material.

"On the basis of this trial experience there will be rewriting during the year, followed by an intensive six weeks rewriting session in Berkeley next June and July with a smaller group of contributors. This revised textual material will then be used in roughly one hundred new high schools in the academic year 1961-62, in eight geographical areas centered around New York City, Philadelphia, northern Florida, Indianapolis, Minneapolis, Seattle, Los Angeles and San Francisco. There will be two summer institutes of six weeks, one at Harvey Mudd College and at Cornell University during the summer of 1961 to each of which approximately fifty participating high school teachers will be invited. It is also contemplated that a good start on the development of the film material will take place during this academic year.

"The present plan calls for the general availability of a basic high school chemistry text and related laboratory manual, films, and monographs as soon as possible after the completion of the second trial of the materials in 1961-62.

Stimulating Introduction

"I find the material written this summer to be an excitingly fresh and stimulating introduction to the science of chemistry. I believe that those school districts which see fit to adapt their high school program to use the material provided by this program or by the alternative Chemical Bond Approach Study and to recruit or retrain teachers to handle it in a competent fashion will soon be able to send their graduates to college with a better understanding of chemistry than students in many colleges receive after a year of chemistry at the collegiate level. If this action is also accompanied by similar changes in the mathematical, physics and biology programs, we shall experience a remarkable strengthening of secondary education in this country."

The indispensability of competent teachers, adequate salaries for them, and tax funds to pay these salaries were acknowledged by Dr. Seaborg.

Various courses, summer institutes for teachers, the Continental Classroom television series, the complete high school course on film, and other projects cosponsored by the American Chemical Society were cited as aids to improved education.

"I urge others within the Society to contribute their time, talents, and support to the continuation and expansion of these programs in their own communities," he said.

Nurturing natural curiosity in elementary school children and keeping graduate education and fundamental research together in colleges and universities were given as examples of other new trends or "currents" in chemical education.

"Because of the enormous size of the educational establishment in the United States it is doubtful that these new currents will cause, within a short number of years, the major improvements we so desperately need," the speaker conceded.

"But significant and heartening improvements have been effected in many institutions, and there is real hope that the forces now being set in motion will eventually cause a thorough strengthening of chemical education at all levels in nearly all of our schools."

New Casting Method

➤ A SIMPLE, inexpensive method of casting statuary which enables an average foundryman to reproduce an artist's work satisfactorily has been developed at the Massachusetts Institute of Technology.

Large statues usually have been cast in segments from wax or plaster patterns. Only a few foundries in this country, consequently have been willing to serve artists.

To demonstrate what can be done with it, the MIT foundry has produced a 400-pound, two-and-one-half-foot-high, bronze statue of Pegasus. Although quite complex, this Pegasus was cast in one piece.

The horse was carved in expanded polystyrene. This was placed in a large flask and surrounded with sand. Bronze then was poured in at a temperature of 2,300 degrees Fahrenheit. This molten metal vaporized the polystyrene and left a bronze Pegasus beneath the sand in 38 seconds.

Development of The American Chemical Society

by WALLACE R. BRODE

Chairman, Board of Directors' Building Committee
American Chemical Society

➤ THE American Chemical Society started first as essentially a New York Society and only after some internal reorganization was accepted as a national society. The first General Secretary of the Society was Dr. Albert C. Hale who served as an officer of the society from 1888 to 1903. He lived during this period in Brooklyn, New York where he was Professor of Chemistry and Head of Physical Sciences in the Boys' High School in Brooklyn from 1883 to 1912. His first official address for the society was Post Office Box 65, but he subsequently used in succession three street addresses for the national office of the Secretary, namely 356 Carlton Street, 551 Putnam Street and 352-A Hancock Street, all in Brooklyn, New York.

Noyes

In 1902 Professor Hale indicated that the Society had grown from 200 to 2000 members during his term of service and that the secretarial duties took so much time as to seriously interfere with his other duties. It was certainly a compliment to the anticipated capacity of Prof. William A. Noyes and his ability to absorb a heavy load, when it was decided to combine the position of Secretary of the American Chemical Society with that of Editor of the JOURNAL OF THE AMERICAN CHEMICAL SOCIETY. Professor Noyes had accepted in 1902 the Editorship of the JOURNAL OF THE AMERICAN CHEMICAL SOCIETY upon the resignation of Professor Hale from the Editorship. Professor Noyes was then a Professor of Chemistry at Rose Polytechnic Institute at Terre Haute, Indiana. On January 1, 1903 Professor Noyes became the Secretary as well as Editor for the Society and the administrative office of the Society left New York.

This marked the break from the traditional New York location, although Professor Hale had actually secured in 1893 the enactment of a bill by the Legislature of the State of New York to exempt the Society from an article of incorporation which required that a certain portion of the Society's officers be resident in New York.

Johns Hopkins

In the summer of 1903 Professor Noyes accepted a position as Chief Chemist for the newly formed National Bureau of Standards in Washington, D. C. He found the Bureau was not ready with its new building, so he made his headquarters at the Chemical Laboratory of his alma mater, Johns Hopkins University, with his good friend, Dr. Ira Remsen. The offices of the Society thus became the Chemical Laboratory of Johns Hop-

kins University from September 1903 to January 1905. The Chemical Laboratory of the National Bureau of Standards (the top floor of what is now known as the South Building) was completed for occupancy in November 1904 and in January 1905 the headquarters of the American Chemical Society came to the City of Washington for the first time.

If the duties of Secretary for the American Chemical Society had been found by Doctor Hale to be of some interference with his other responsibilities, it certainly is a tribute to Professor Noyes that he was able to create a new research laboratory, effectively lead its research and service work (he received the Nichols Medal in 1908 for his work on the atomic weights of hydrogen and chlorine done during this period) and at the same time to serve the American Chemical Society as its General Secretary, the Editor of the JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, and also in this same period to lay the plans, and serve as its first editor for CHEMICAL ABSTRACTS.

Parsons

In June 1907 Professor Noyes advised the Council that he would have to resign from some of his duties because of the rapid growth of the Society. It was decided to separate the positions of Secretary and Editor; and Professor Noyes, who had accepted a position as Chairman of the Department of Chemistry at the University of Illinois, took with him the editorship of the JOURNAL OF THE AMERICAN CHEMICAL SOCIETY and of CHEMICAL ABSTRACTS. On September 1, 1907 Professor Charles L. Parsons, Chairman of the Department of Chemistry at New Hampshire College, Durham, New Hampshire was made the Secretary and the operating headquarters of the Society left Washington. For a period of five years Durham, New Hampshire was the official business address of the ACS, until 1911-12 when Doctor Parsons accepted the position of Chief Chemist of the newly organized Bureau of Mines and the Society headquarters again came to Washington.

Our address, during the period of the U. S. Bureau of Mines hospitality, however, never became the Bureau of Mines, as had the earlier Washington address been the National Bureau of Standards, but was always a Post Office Box (Box No. 505). In fact, in spite of a Post Office Box Number, we enjoyed the hospitality of the U. S. Bureau of Mines from 1911 to 1919. The use of a Post Office Box may have been a foreshadowing of the increasing load we were placing on our host institution's hospitality and the growing need for a separate headquarters.

Bureau of Mines

As in the case of the first move of the Society headquarters to Washington by Doctor Noyes, the exact date of Doctor Parsons' move is somewhat nebulous since, as in the earlier case, the scientific organization was newly formed, and it is evident that the gradual move from New Hampshire to Washington was due to some of the problems which accompany the organization of a new laboratory or group. The Society history gives September 1, 1912 as the moving date. Even through the Bureau of Mines

lists Doctor Parsons on the pay roll in 1911, the Faculty of New Hampshire College gave Doctor Parsons a going away present in September 1911 and Doctor Parsons addressed the Columbus Section of the American Chemical Society on November 2, 1911 on his new work at the Bureau of Mines.

In any case we do know that the second offices of the American Chemical Society in Washington and the first location of the U. S. Bureau of Mines was on the Northeast corner of 8th and G Streets, N. W. in a four story red brick building (now painted grey). This, like the earlier Johns Hopkins address, was of a somewhat temporary nature; and in May 1913 the Bureau of Mines moved into more spacious quarters in the Busch Building which is located on the south side of E Street, in the middle of the block between 7th and 8th Streets, N. W. This building is still standing, and although it also was a red brick building at the time of our occupancy, it is now a gleaming white building and is a part of Lansburg's Store. Here adequate space was available so that Doctor Parsons had a separate room for his Chemical Society work. Doctor Parsons' office was on the fourth floor with an elegant bay window facing E Street. Doctor Parsons was Chief Chemist of the Bureau of Mines from 1911 to 1917 and Chief of the Division of Mineral Technology from 1911 to 1919. He resigned the position of Chief Chemist in 1917 because of the increasing load of the ACS work. During his Bureau of Mines years he did not receive a salary from the Society but rather was paid a set commission and was allowed funds to pay for secretarial assistance. On April 6, 1917, with the two ACS employees, the Bureau of Mines moved to the newly completed Department of Interior Building where Doctor Parsons had an office on the first floor in the southeast area of the building (Corner of 18th and E). The ACS services occupied the corner room.

P. O. Box 1505

In the early spring of 1919, for some mysterious reason our post office box number was changed from 505 to 1505. The correspondence and some letters to the editor carried comments at this time about the anomalous character of a Post Office box as the National Headquarters and the inaccessibility of the Secretary to those who might visit Washington or telephone or telegraph, and were not aware of our host institution's location. Eventually the Secretary did provide a Bureau of Mines address in indicating that Express shipments to the Secretary should be sent to the Bureau of Mines. At the spring meeting of the Society in Buffalo there was a discussion in the Council meeting of the need for separate quarters for the administration of the Society.

Obviously these pressures, as well as the major factor of the growth of the Society, must have all been instrumental in the initiation of the proposal from Doctor Parsons to the Board of Directors, at the June meeting in 1919, that he resign from the Bureau of Mines, rent suitable office space in a fireproof building (not more than 1000 square feet at not more than $1500 per annum) and establish an office of the American Chemical Society. The Board accept-

ed this proposal, and because the Secretarial position was not even then considered a full time position, the Board authorized Doctor Parsons to engage in private consulting, if he so wished, up to 50% of his time. They also raised the commission to be allowed the Secretary from $3,500 to $5,000, in recognition of the growing responsibility. In September 1919 Doctor Parsons moved his office and his four ACS employees to the 7th floor of the Mills Building at 1709 G Street, N.W., which remained the society address until we moved to our present location at 1155 16th Street, N.W.

In the interim between 1902, when Professor Noyes took over the entire publication program of the American Chemical Society, and the present, there has been considerable separation and division of publications in what might be considered a normal process when either size or content reaches a critical state. CHEMICAL ABSTRACTS was created in 1907 and was transferred to Doctor Patterson at Ohio State University in 1911. In 1909 the journal of INDUSTRIAL AND ENGINEERING CHEMISTRY was created through a committee of which Professor Noyes was a leader. The first editor lived in Chicago and the editorship of this journal later moved from Chicago to New York; and in 1922, under the editorship of Harrison Howe, the editorial offices were moved to Washington. Howe did not join at once with the Secretary, but located two blocks away at 810 18th Street, N.W.

Centralized Office

In 1927 Howe moved into the Mills Building on the floor above the Secretary's office and there was thus created for the first time since 1907 the semblance of a centralized office of the American Chemical Society for both Secretarial and Publication activities. Gradually other Society activities have been added to this growing nucleus including financial activities, local section services and other items which provided a centralized and coordinated community service for the Society and its members.

With the combination of these many activities there was an even greater and growing evidence for the ultimate need for a separate Society building. Such a move was effected with almost dramatic suddenness, due to a fortunate moment in the real estate market, with an authorization by the Board of Directors and acquisition of the former building on the site of this new Building all consummated in three weeks in December 1940, for a sum of $150,000 which was in fact a good buy for the land alone without the attached building. Dr. Charles L. Parsons, with the aid of the Society's Assistant Manager Alden H. Emery and Editor Harrison E. Howe, together with the 26 other employees of the Society, moved into this remodeled apartment house in May 1941 and since then the address of the Society has been 1155 16th Street, N.W.

At first the spacious character of this apartment building (18,700 sq. ft.) permitted us to rent a considerable portion (13,000 sq. ft.) to sister scientific societies, but gradually the number of ACS employees and activities increased so that in 10 years, we took over the entire building space and soon we were bulging at the

seams and renting outside space. Doctor Parsons retired in 1946 and Alden H. Emery was appointed Executive Secretary. The fiscal programs were brought to Washington under Robert V. Mellefont as Treasurer in 1948. By 1954 it was obvious that we would either have to move or build to keep up with the future expansion of science. As opportunity arose we acquired bits of land surrounding our building so that we now hold an area equal in size to about twice the area covered by our new building, which will provide for future expansion.

New Building

After a careful four year study and planning program by the Board of Directors and administrative officials an appeal was presented by Dr. Ralph Connor as Chairman of the Board of Directors under the title of "A New Building for the American Chemical Society." This appeal laid the groundwork for the decisions by the Council and Board of Directors in September 1957 to proceed with the plans and eventually the actual construction of this new building.

Dr. Alden H. Emery as Executive Secretary with the Society's 224 other employees moved to temporary quarters at 1801 K Street, N.W. in June 1958. The apartment building was demolished and ground was broken for the new building on January 30, 1959. The cornerstone for the new building was inserted in an impressive ceremony on December 5, 1959 and in late January 1960 we acquired occupancy.

When, in 1958, the Society moved to temporary quarters at 1801 K Street, N.W., it had 225 employees with a space requirement of 35,000 square feet; now, at the close of 1960, due to Society growth and centralization of activities previously conducted elsewhere it has 300 employees in the building and occupy some 45,000 square feet of the total 80,000 square feet available (including our library, conference and assembly room space). It has reasonably adequate expansion possibilities for it has completed centralization of many of its activities which were performed elsewhere.

The national headquarters (built at a cost of about four million dollars) are relatively modest in size and character when one considers that it operates on an annual budget of more than $10,000,000 and that it has some 600 part and full time employees, not including the several thousand abstractors, nor for that matter, the more than 90,000 members who also work for Chemistry and the Society.

Fallout Nearly All Rained Out

➤ The 1960 spring rains, besides bringing out the flowers, brought down from the high atmosphere considerably less radioactive strontium-90 than in 1959.

The 1959 spring rains held the greatest amount of strontium-90 on record, Dr. Lester Machta of the U.S. Weather Bureau told an American Meteorological Society meeting. He believes the maximum exposure to whatever hazards strontium-90 presents has already occurred.

The radioactivity from this fallout product is now disappearing (decaying) at almost the same rate as it is being precipitated on the earth's surface as rain or snow.

Apparatus Article

Gold Recovery Unit

➤ THE GOLD SAVER shown above, was introduced by Technic, Inc., Providence, R. I., as the first commercial unit for recovering gold lost in electroplating. The Gold Saver includes a column of special resin and a pump for circulating through the resin column the water in which gold is dissolved. Until now between 4 and 10 per cent of all gold used in electroplating simply has gone down the drain. However, one electroplater, using the unit on a trial basis, will have recovered enough gold in less than three months to pay for it.

Basically, the unit consists of:

— A column of special resin, small "BB" size particles, which capture gold in solution that now is being lost;

— A pump for circulating through the resin column the water in which the gold is dissolved; and

— Pipes, hoses, and connections between the pump and the special resin column.

After an item is plated with gold, it is immediately immersed in a tank of water to rinse off and save the plating solution, which frequently costs between $40 and $50 a gallon.

Over a period of time, the concentration of gold solution in the drag-out tank builds up until, because of its gold content, it is worth possibly $10 a gallon. Periodically contents of this tank are added to the gold plating tank to keep the plating solution at a workable level and to recover some of the gold.

In the past, the plated item was then rinsed in running water, and the gold "drag-out" from the drag-out tank was lost.

The Gold Saver comes before this water rinse.

The unit is attached to a tank into which the plated item is dipped, after the drag-out tank. The pump continuously circulates the solution through the special resin trap, where the gold is picked up.

The work, free of gold, is then rinsed in running water.

When the resin is completely saturated with gold it may be burned by the plater to recover the gold, sent to a refiner, who would also recover the gold by burning, or it may be returned to the Technic laboratories for reclaiming.

Beryllium Detector

➤ A BERYLLIUM detector has been perfected to help prospectors find new deposits of this space-age element. Beryllium, a silver-white, hard, workable metal, is sought after for space uses because it combines a high melting point with high strength and light weight.

Developed at the University of Manitoba, Winnipeg, Canada, the Berylometer uses "hard" gamma rays, at least 1.6 mev, emitted by radioactive antimony to bombard a rock sample. If beryllium is present, these gamma rays force the metal to release neutrons. A scintillator counts the released neutrons. No other element can interfere to give a false reading.

Louis and Pauline Moyd, Yonkers, N. Y., consultants, told the American Institute of Mining, Metallurgical and Petroleum Engineers that the portable instrument passed the field tests they gave it.

The instrument detected three different kinds of known beryllium deposits, and several discoveries were made during the tests. The instrument also proved the absence of significant amounts of beryllium that had been erroneously reported earlier because of faulty chemical or spectrographic analyses or incorrect mineral identifications.

In one case, large boulders in a relatively inaccessible glaciated area were checked. The boulders were covered by lichen — tiny plant life. More than a hundred were checked before one, then several nearby, produced indications in the instrument. These were later found through assay to have rich concentrations of white beryl.

The detector may never equal the Geiger counter's prominence as an amateur prospector's aid, however. Its radioactive heart means the user must have special training and a license. The radioactive antimony decays at a known rate and must be replaced every four months.

Proudly Presented

Announcing new developments in the chemical industry and newly available chemical literature.

International Institute of Synthetic Rubber Producers

➤ The continued growth of the synthetic rubber industry on a worldwide basis has brought about the formation of an International Institute of Synthetic Rubber Producers.

The Institute was organized by 15 U. S. and foreign synthetic rubber producers. Its purpose is to provide an effective means of promoting international trade of synthetic rubber.

The worldwide production of this important commodity has increased almost four times in the past decade. In 1959 the combined production of synthetic rubber from all countries totaled 1,640,000 long tons as compared with the 440,331 long tons produced in 1949.

Another purpose of the Institute is to fill the need for a forum in which manufacturers and technicians all over the world may exchange technical ideas and information to encourage scientific advances within the synthetic rubber industry.

Membership in the Institute is open to any interested and qualified manufacturer of synthetic rubber. The membership will be subdivided into sections because industry needs may exist in certain geographical areas which are not common to manufacturers in all parts of the world. Initially there will be a European and North American section.

The affairs of the Institute will be administered from a principal office in New York City. Establishment of a subsidiary office is planned in Europe to serve the needs of that section.

Plans Announced for Fertilizer Plant

➤ Plans for the construction of what will be one of the nation's largest chemical fertilizer plants have been announced by the California Spray-Chemical Corporation.

Calspray is a subsidiary of California Chemical Company, which in turn is a wholly-owned subsidiary of Standard Oil Company of California.

The $22 million plant food facility will be built in the heart of the Midwestern farm belt at Fort Madison, Iowa. It will be capable of producing more than 1000 tons daily of a wide variety of chemical fertilizers. The new installation will primarily serve the expanding requirements of the North Central markets.

New High-Performance Polysulfide Polymer

➤ A new solid propellant rocket binder combining the high performance of hydrocarbons and the superior processing and broad performance characteristics of polysulfides has been developed by Chemical Operations, Thiokol Chemical Corporation. Possessing superior properties of low temperature flexibility and resistance to aging at high temperatures, the new polymer, designated C-12, is now being evaluated by the Corporation's Rocket Operations to determine optimum viscosity and molecular linkage.

Chemical Patents

To obtain copies of these new patents, order them by number from the Commissioner of Patents, Washington 25, D. C. Enclose 25 cents in coin, money order or Patent Office Coupons (but not stamps) for each patent ordered.

Free-Flowing Granular Brown Sugar

➤ COMMERCIAL brown sugar is commonly marketed in a moist form. It is usually packaged in cartons or bags with moistureproof linings. As brown sugar dries out it tends to cake and to harden.

Mr. Alfred Lachmann of Haddonfield, N. J. has been granted patent No. 2,910,386, No. 2,910,387, No. 2,910,388, and No. 2,910,389 for his process that produces an improved free-flowing non-caking brown sugar in a granular form. He accomplishes this by coating ordinary granular brown sugar with a small amount of a relatively non-hygroscopic, edible, pulverulent material. This material can be either organic or inorganic in nature. He describes the use of starch and calcium silicate among many others. The patent was assigned to The American Sugar Refining Company of New York.

Novel Process for Upgrading Gasoline

➤ THE MODERN automobile is given engines with greater horsepower and higher compression ratios. These engines require gasolines of higher octane ratings. Patent No. 2,905,619 was awarded Mr. Robert E. Sutherland of Chicago, Illinois.

The new process fractionates gasoline into a C_6 fraction and a C_7 fraction. The C_7 fraction is subjected to catalytic reforming to upgrade it. The reformed material is the fractionated as before and the new C_6 fraction is added to the first C_6 fraction. The mixture is then subjected to isomerization to form branched hydrocarbons. The isomerized products are then mixed with the new C_7 fraction.

The patent was assigned to Universal Oil Products Company of Des Plaines, Illinois.

Silicon-Containing Ice Colors

➤ THE AZO DYES which contain the N=N group are a very important class of textile dyes. They are referred to as the ice colors also because they require cooling by ice in their preparation and use. A new class of these azo dyes has been described by Mr. Donald L. Bailey of Snyder, N. Y. and Mr. Ronald M. Pike of Grand Island, N. Y. They have been awarded patent No. 2,957,744 for those azo dyes containing silicon.

The compounds covered in this patent have the general formula:

$-N=N-Ar-C_aH_{2a}-Si-$, in which Ar represents the phenylene radical or a substituted phenylene radical and the subscript *a* is an integer with a value from 0 to about 8. In the typical dyeing example a cotton fabric is impregnated with 2-naphthol and then

immersed in diazotized beta-aminophenylethyltriethoxysilane solution. A brilliant red color is developed on the fabric. The patent was assigned to Union Carbide Corporation of New York.

Alumina Particles Separated From Aqueous Slurry

➤ WHEN ALUMINA is ground in steel ball mills it often becomes contaminated with iron. Grinding is necessary in order to produce the extremely small particle size required for ceramic slips. The removal of the iron contaminant is usually accomplished by acid leaching. During the leaching process the alumina particles tend to deflocculate and to form a fine suspension that is very difficult to filter.

Mr. Leo M. Schiffereli of Kokomo, Indiana was awarded patent No. 2,957,821 for a process that separates this solid-liquid suspension. His process involves the addition of at least one agent from the group consisting of monoethanolamine, ammonium hydroxide or a compound in the class of organic amines and bases to the acidic alumina slurry. The pH of the suspension is changed from about 3 to about 8 during this process. The patent was assigned to Union Carbide Corporation of New York.

Chemical Production with Nuclear Energy

➤ AEROJET-GENERAL Nucleonics has announced progress in using nuclear energy to transform a cheap and plentiful chemical into a powerful space age fuel.

Producing one compound from another by using nuclear energy is a new field called fissio-chemistry. Pioneering in this new peaceful application of the atom, Aerojet-General Nucleonics already has conducted extensive research on the fissio-chemical production of nitric acid. This work led to a contract with the Air Force Manufacturing Technology Division of the Air Materiel Command's Aeronautical Systems Center to investigate the possibility of producing the space age fuel hydrazine from plentiful and cheap liquid ammonia.

Test equipment for the fissio-chemical production of hydrazine is now being completed and it is planned for in-reactor operation early this fall. Anhydrous hydrazine will be produced directly, thus avoiding present expensive separation steps used in conventional plant. Other chemicals used in the conventional process, such as chlorine, will not be required.

If the experiment is a success, knowledge gained could lead to the development of a plant designed to produce hydrazine at a fraction of its present cost through the use of a nuclear reactor. Air Force sponsorship of the program is based on the possibility of appreciably reducing production costs.

Hydrazine, a powerful but storable fuel, offers near instant reaction time to liquid propellant ICBM range missiles. It has vast potential for space applications because of its density, storability and burning characteristics. It can also be used as a mono-propellant for vernier jets, gas generators and for other auxiliary power units.

Monsanto

This is the third of a series of eight articles to be presented in CHEMISTRY this year. Many of the students now preparing for a career in chemistry will eventually join one or other of the large corporations and this series, featuring eight of the major companies employing chemists in the United States, is intended as a preview into the type work that they will be doing.

➤ MONSANTO Chemical Company, with headquarters in St. Louis, Mo., operates chemical manufacturing plants in fifteen states and produces several thousand varieties and grades of compounds. The company has substantial investments in chemical plants overseas and its products are sold throughout the free world.

With total assets of about a billion dollars and more than 30,000 employes world-wide, Monsanto represents one of the outstanding examples of growth in the chemical industry. The firm opened its doors for business in 1901 as the sole American supplier of saccharin, and the super-sweetener was the company's only product. The saccharin was produced in the corner of a St. Louis warehouse by the oxidation of toluenesulfonamide imported from Switzerland.

A few years later, the company added vanillin, phenolphthalein and coumarin as products, and it continued to grow in the field of flavoring. The American Chemical Company cut off by World War I from its European supply of chemical intermediates, was forced to become self-sufficient, and the laboratories of Monsanto not only helped in this but led the company into production of basic chemicals.

Monsanto today is the world's largest producer of elemental phosphorus, is active in the field of plastics, a leader in agricultural chemicals, and its organic chemicals enjoy an international reputation. The chances are good that the polyvinyl butyral interlayer in your car's laminated safety glass windshield, the vanilla flavoring in your ice cream, the active ingredient in your aspirin tablet or your synthetic detergent, all were formed in a Monsanto chemical plant.

Divisional Groups

To discharge its responsibilities in the quick-paced chemical industry, Monsanto is organized into divisions, each of which specializes in a particular area of chemistry.

The Agricultural Chemicals Division is concerned with both inorganic and organic chemistry as applied to the farm. The division produces fertilizers such as urea, ammonium nitrate and liquid solutions of nitrogen. It also is engaged in manufacturing herbicides and insecticides.

The Inorganic Chemicals Division is interested in the wide area its name implies. Ultra-pure silicon of electron-

▸ PIONEERING *in the use of plastics as a new construction material, Monsanto built this demonstration house at Disneyland Park, Anaheim, Calif. In three years, some six million visitors have walked through the "Plastics Home of the Future" and its structural performance has been outstanding.*

ic use, phosphates for use in baking and detergents, phosphoric acid for the metal industry and the soft drink industry are among the many products it makes. The division mines phosphorus bearing ores in the South and West and produces elemental phosphorus by the electric arc method. It offers engineering and construction facilities in the erection of vanadium-catalyst sulfuric acid plants and De Nora cell chlorine plants.

The Lion Oil Company Division is basically established in the petroleum industry. The division has producing wells and considerable reserves, as well as a far-flung exploratory program to develop new oil-producing properties. It markets gasoline and petroleum products under the Lion name, and supplies petroleum derivatives for chemical processing. One example of the possible efficiencies in this area is a facility which removes sulfur from natural gas produced by Lion. The sulfur is used in the manufacture of sulfuric acid, which goes into fertilizers, while the cleaned gas can be used either as a fuel or in chemical work.

Organic Chemistry

The Organic Chemicals Division still produces the saccharin which gave Monsanto its start, and it has

other products almost too numerous to mention. The division is a basic supplier of chemical intermediates derived from a wide variety of processes. Beginning more than fifty years ago with sulfonation products, Monsanto has progressively developed facilities and know-how for the production of chemicals by many techniques including nitration, chlorination, caustic fusion, alkylation, hydrogenation and so on. Fine chemicals, resin materials, plasticizers, rubber processing compounds, petroleum additives, functional fluids, paper chemicals and wood preservatives are among the division's products.

The Plastics Division produces its own basic monomers for styrene, ethylene, vinyl and acrylonitrile polymers and copolymers, and offers molders, coaters, extruders and fabricators a wide variety of plastics compositions. In addition to their familiar use as packaging materials, modern plastics insulate electric wires, protect rocket nose cones from re-entry heat, and perform a multitude of other tasks. Latexes of styrene provide the main vehicle and protective colloid for water-base paints, and the resin finds applications in battery separators, in rubber compounding and as an additive for emulsion waxes.

➤ Pre-emergence herbicides *developed by Monsanto in this greenhouse include one which will kill grassy weeds while permitting corn, a grass itself, to grow. The chemical is sprayed into the soil at planting time. Another chemical will control wild oats while permitting crops closely related to it to flourish. The "chemical hoe" has contributed greatly to the productivity of American farmers.*

Research

The Research & Engineering Division emphasizes research on new or improved products and processes. To maintain and nourish its broad line of chemicals, plastics and petroleum products, Monsanto maintains a research program of increasing scope and depth. Chemists and chemical engineers look for new products and processes, better ways of doing things or ways of doing things which are not being done.

Historical works on the chemical industry contain many paragraphs on the advances Monsanto has made. It was Monsanto's work on the alkylated aromatic hydrocarbons which led to the synthetic detergents in wide use today. The company's studies on the combination of alkylene oxides with other reactive chemicals, and studies on the mechanism of wetting and detergency resulted in the first non-foaming detergent, so important to efficient operation of the automatic home laundry machine.

Another example of Monsanto's work is its continuous program of research on antibacterial and antifungal compounds. Nearly 20 years ago this program produced pentachlorophenol, well known as a wood preservative. Extension of this work to household products led to many other discoveries which are in daily use, such as bacteriostats which can be incorporated in bar soap.

In the late 1920's, Monsanto began a plan of delegating authority and responsibility downline as far as possible among its technical, administrative and supervisory people. There is clear-cut delegation of authority but

➤ CHEMICAL *research today may even include study of the life processes. This chick will have his metabolism studied in a specially constructed chamber. This project is designed to determine the effect of 6 Ethoxy 1,2-Dihydro 2,2,4-Trimethyl Quinoline, an anti-oxidant, in protecting vitamins in animal feed.*

with the decided attempt to let the individual run his job his own way.

This program has been fruitful in administration as well as in research. It affects sales groups and production teams and plays a major part in the satisfaction that each Monsanto employe finds in his work.

Employe Relations

The company follows a general policy of promotion from within and makes a sincere effort to employ the best qualified individuals. College level training in chemistry and engineering is required for employment in those specialities, and is useful in technical sales and even advertising and library work in the complex chemical industry. Often overlooked,

however, is the importance of electrical and mechanical engineering in the modern chemical plant, where pressures and temperatures rise as quickly as new materials to handle these become available.

Since World War II, Monsanto's corporate growth has entered a new phase. It has been a growth through partnership. With American Viscose, for example, the company joined to form The Chemstrand Corporation, now prominent in the field of synthetic fibers. Monsanto contributed its knowledge of high polymer chemistry; American Viscose contributed its skill in the production and distribution of textiles.

Monsanto with Farbenfabriken Bayer of Germany formed Mobay Chemical Company to pioneer, in this country, the development of urethane chemistry. In addition, Mitsubishi Monsanto has been formed with Japanese interests; Monsanto Boussois has been formed with French interests; Sicedison has been formed with Italian interests.

Monsanto is active in Great Britain, Australia, Canada, Mexico and Latin America. The company has often expressed the belief that its broad international base will produce considerable future benefits for its customers and its shareholders, as well as for its employes.

Gas and Liquid Electric Circuits

➤ Electronic circuits may be replaced, at least in some Army equipment, by control devices that use liquids or gases, instead of electricity, and that have no moving parts.

Applications of the new control devices, developed by B. M. Horton, R. E. Bowler and R. W. Warren of the Army's Diamond Ordnance Fuze Laboratories, may also include such civilian tasks as controlling dishwashers, power tools and computers.

The simple units consist of a block of metal or heavy plastic in which passageways have been made. They can perform the same complicated functions of complex electronic circuits in a computer or control device.

Today's weapons of warfare are often controlled by computer-type devices. This gear presents many problems of transportation, maintenance, and repair. In the field, especially under combat conditions, these problems are magnified. Electronic apparatus must be carefully handled and deteriorates rapidly when subjected to extremes of heat and cold, humidity and shock.

The new system is virtually invulnerable to those conditions. Its storage or shelf-life is practically unlimited. Because it has no moving parts to wear out, maintenance and repairs are minimized.

The three civilian scientists have already successfully developed units which can perform amplification, feedback, digital computation, analogue computation, normal mathematical and memory functions.

The new pure fluid amplifiers work by directing a low weak stream of fluid against the side of a strong stream. The weak stream, called the "control stream," displaces or redirects the "power stream" that does the real work.

For the Home Lab

Hydrochloric Acid

by Burton L. Hawk

➤ Last month we cast our ballot for sulfuric acid as the most important industrial chemical ever produced. This month we should like to nominate hydrochloric acid as a runner-up. Certainly, next to sulfuric, it is the most useful acid. It is important in varied industries and in the production of metallic chlorides which are also very useful in industry.

First, last, and always, hydrochloric acid is a typical acid. Unlike sulfuric which plays several roles as a dehydrating agent, reducing agent, catalyst, etc., hydrochloric acid performs primarily as an acid. It performs well; it is one of the strongest acids known and is considerably stronger than sulfuric acid.

Chemical Properties

As a typical acid, hydrochloric reacts with the metals above hydrogen in the electrochemical series. Pour a dilute solution of hydrochloric acid into each of five test tubes. Drop into the tubes, respectively, a piece of magnesium, aluminum, zinc, iron and tin. Note the action which should decrease in vigor from magnesium through tin. The chlorides of these metals are obtained and hydrogen is released.

As a typical acid, hydrochloric reacts with the oxides of the metals. Sift a small quantity of magnesium oxide, calcium oxide and zinc oxide into three tubes containing dilute hydrochloric acid. Note the oxides are dissolved again forming the chlorides of these metals. For a more colorful demonstration, add a small quantity of cupric oxide to dilute hydrochloric acid. The solution is black at first. Apply gentle heat. Gradually the oxide is dissolved and a beautiful clear emerald green solution is obtained. Upon diluting with water, the green color will change to light blue. This is cupric chloride.

As a typical acid, hydrochloric reacts with the carbonates of the metals. A good example here is calcium carbonate. This material added to dilute hydrochloric acid will react vigorously to form calcium chloride.

Neutralization

As a typical acid, hydrochloride reacts with the hydroxides of the metals. The classic example is the neutralization of the strong base, sodium hydroxide, with the strong acid, hydrochloric. Here we have two extremely caustic and posionous materials which, when mixed together, produce two materials vital to life: water and common salt. To a solution of sodium hydroxide, add a drop of phenolphalein solution. A pink color will develop. Now add dilute hydrochloric acid, in small quantities and finally drop by drop, until the pink color *just* disappears. You now have a perfectly harmless solution of common salt. (Don't taste it; just take our word for it.)

Preparation

Hydrochloric acid is a solution of hydrogen chloride gas dissolved in water. Hydrogen chloride is released

from chlorides by the action of sulfuric acid. Of course, sodium chloride will be the logical compound to use. Place 10 grams of it in an Erlenmeyer flask. Add enough water to just cover the salt. Insert a 2-hole stopper in the flask containing a thistle tube and an outlet tube. Be sure the thistle tube extends into the flask far enough so that the end is under the water in the flask. Extend the outlet tube into a small beaker partially filled with water. The end of the tube should dip about ¼" below the surface of the water in the beaker. Now carefully add a small portion of concentrated sulfuric acid to the salt in the flask by pouring through the thistle tube. The action should be quite vigorous. Apply gentle, even heat and continue to add sulfuric acid in small portions. Hydrogen chloride is generated and is dissolved in the water in the beaker. Do not allow any of the water in the beaker to suck back into the reaction flask. If this should start to happen, apply stronger heat. Continue the reaction for a short time, then remove the outlet tube from the beaker *BEFORE* you discontinue heating. This is very necessary to prevent the water being sucked back into the flask on top of the hot sulfuric acid . . . a solution which is not desirable at this time.

The hydrochloric acid produced should be quite strong. Place a small quantity of it in a test tube and add a piece of zinc. It should react vigorously. If you wish, you may use the acid you have made for the reactions described herein.

Although it is not as effective, hydrochloric acid can be prepared without using sulfuric acid. Hydrated magnesium chloride, when heated, will decompose forming hydrogen chloride vapors. Place about ½ gram of hydrated magnesium chloride crystals in a dry test tube. Connect a delivery tube to the test tube leading to water contained in another tube or small beaker. Heat the crystals carefully and evenly. The vapors of hydrogen chloride will pass through the delivery tube and dissolve in the water converting it to hydrochloric acid.

Hydrochloric acid is used extensively in the production of many gases used in the chemical laboratory.

Hydrogen — Simply add a piece of zinc to dilute hydrochloric acid. Hydrogen is quickly evolved. To demonstrate, place an empty test tube atop the reacting tube for a minute to collect the hydrogen evolved. Continue holding the tube in this inverted position (with holder) and transfer it to a flame (away from the generator tube). An explosive "pop" will indicate the presence of hydrogen.

Chlorine — Oxidizing agents will liberate chlorine from hydrochloric acid. Add manganese dioxide to dilute hydrochloric acid in a test tube and heat gently. Chlorine is obtained. Look for the greenish vapor. Smell *cautiously* at the mouth of the tube.

Carbon Dioxide — Marble chips (calcium carbonate) added to dilute hydrochloric acid provide a convenient source of carbon dioxide.

Sulfur Dioxide — Add a little sodium bisulfite to dilute hydrochloric acid. If you smell cautiously, you will be able to detect the odor of sulfur dioxide.

Hydrogen Sulfide — Add dilute hydrochloric acid to ferrous sulfide in a test tube. The famous rotten-egg odor will soon make itself known.

√ *Chemistry Quiz* √

Directions: Mark the answer you think *most nearly correct.*
Answers are on page 38.

A. The Geiger counter is an instrument used for detecting
1. bacteria
2. isotopes
3. radioactive atoms
4. ultra-violet rays
5. heavy hydrogen

B. When a substance passes directly from the solid state to the gaseous state and back again it is said to
1. evaporate
2. sublime
3. condense
4. boil
5. amalgamate

C. Water is "soft" when it
1. is liquid.
2. contains a base in solution.
3. is filled with silt.
4. contains no substances that precipitate soap.
5. contains no salts.

D. Spontaneous combustion occurs
1. in the absence of oxygen.
2. only in the absence of moisture.
3. only at high temperatures.
4. with non-oxidizable materials.
5. with reducing agents.

E. Water is a very important substance because it
1. cannot be decomposed.
2. does not enter into chemical reactions.
3. always remains a liquid.
4. is insoluble in acetic acid.
5. is a good solvent.

Rare Earths Finding Nuclear Jobs

➤ THE RARE EARTHS, actually not at all rare in nature, are finding more and more jobs to do in industry, particularly in the field of nuclear ceramics. The demand for the 15 elements of this series will increase in the future.

These ceramic-like materials have high melting points. This quality appears to make them suitable for such new uses as crucibles in which metals, glass and enamels can be melted, and also for jobs where a material must withstand high nuclear radiation. Rare earths can be used in control rods for nuclear reactors, and also as a radiation shielding ingredient in concrete.

G. L. Ploetz, supervising ceramist, and A. T. Muccigrosso, ceramist, both of General Electric Company's Knolls Atomic Power Laboratory, Schenectady, N. Y., told an American Institute of Mining, Metallurgical and Petroleum Engineers meeting that new electronic applications will also swell the demand for rare earths, otherwise known as lanthanons.

Science Talent Search
Project Report

Investigation of Polysaccharides

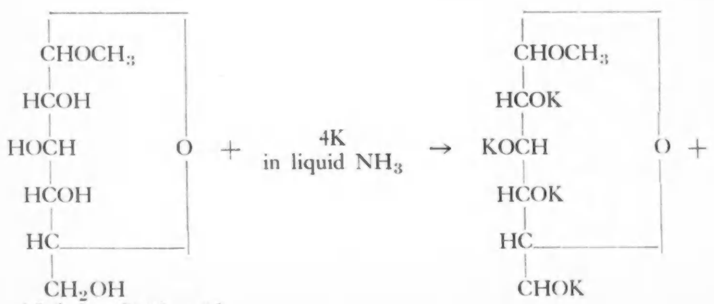
by Betty Lou Snarr
Classen High School, Oklahoma City, Oklahoma

Betty Lou Snarr, 18, was a winner in the 19th Science Talent Search. She intends to study physical chemistry in college preparatory to becoming a research chemist.

➤ In many instances it is important that the exact structural configurations of a polysaccharide be known. Because of the many arrangements and linkages possible in this type of molecule, the analysis of a polysaccharide structure may at times pose something of a problem.

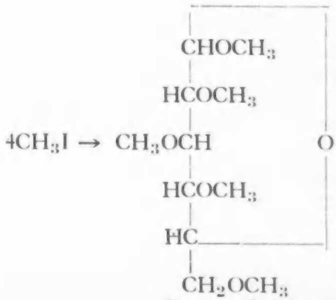
However, if a technique were developed by which the position of all the free OH groups could be determined, the solving of the entire structure would then be but an elementary matter.

It has long been known that certain alcohols will react with alkali metals to form salts. These salts may then be transformed to their corresponding ethers by treating them with alkyl halides in liquid ammonia. This suggests that the analogous process might be applied with profit to the saccharides. This has, indeed, proved quite successful. For instance, since methylglucoside is soluble in liquid ammonia, as are all the saccharides, it can be treated with potassium to form the salt, and then may be reacted with methyl iodide to form the methylated derivative:



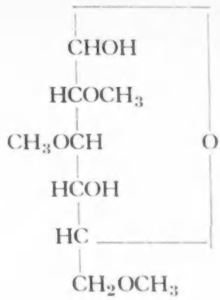
Methyl α-D-Glucoside

➤ Betty L. Snarr *shows her science display in an exhibit held in Washington as a feature of the nineteenth annual Science Talent Institute. Betty is one of the 40 Science Talent Search winners who were chosen from over 29,000 high school seniors throughout the country.*

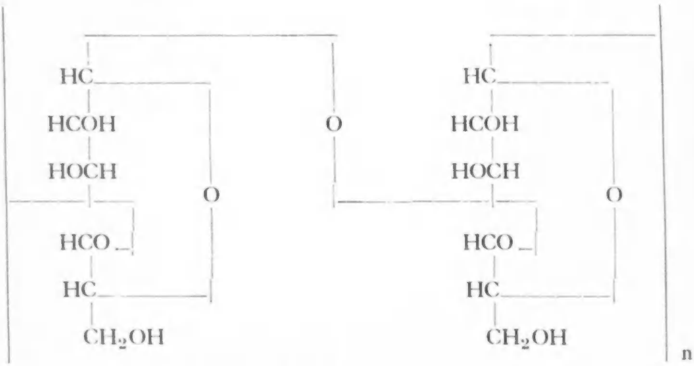


Pentamethylglucoside

Thus all free OH groups are replaced by the readily detectable CH_3 groups. This provides a quite elegant means of determining polysaccharidal structures. If the positions of the free OH groups are known, the monosaccharide units may be determined, their linkages analyzed, and the branching and length of the molecules discovered. For instance, the methylation and hydrolysis of starch results principally in 2, 3, 6-trimethylglucose:



It is evident that this indicates a structure consisting of repeated maltose units:



The amounts of 2, 3, 4, 6-tetramethylglucose and 2, 3-dimethylglucose present in the methylated starch indicate that some branching takes place in the 6 position of the glucose units, and that the molecules have fifty to seventy branches, each about twenty-five to thirty glucose units long.

The macro technique for the methylation of polysaccharides is a rather impractical one, being expensive, time-consuming, and wasteful.

However, several have developed semimicro methods of methylation, notably H. S. Isbell,[1] whose technique is based on that of I. E. Muskat.[2] It is an effective and comparatively inexpensive method.

Commercial ammonia is used, for it is quite pure and practically anhydrous. About 20 milliliters is distilled into the liquid ammonia reser-

[1] H. S. Isbell, et. al., *Analytical Chemistry*, October 1957.

[2] I. E. Muskat, *Journal of the American Chemical Society*, 56, 693, (1934)

voir immersed in a dry ice-acetone bath. (See Figure 1.) This distillation prevents iron contamination, and thus avoids the formation of complicating amides, which is catalyzed by iron.

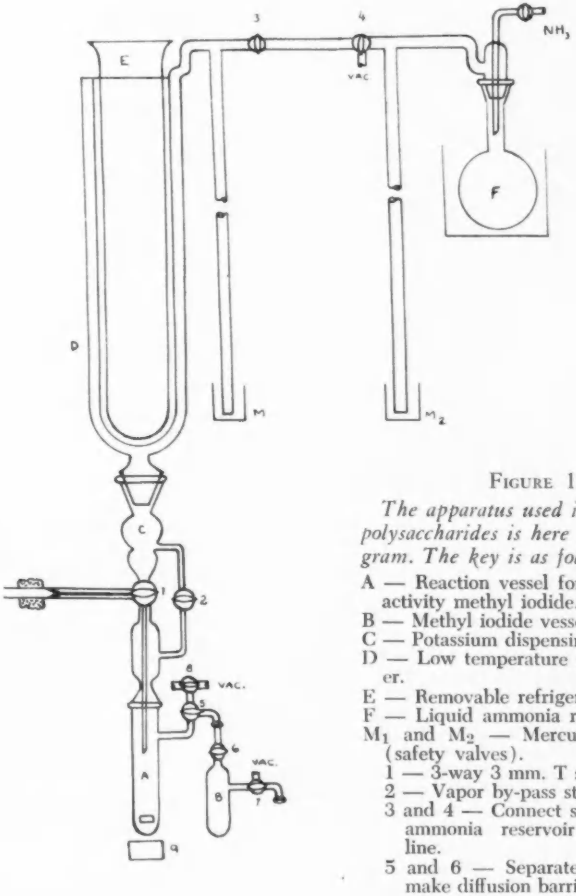


FIGURE 1

The apparatus used in methylating polysaccharides is here shown in diagram. The key is as follows:

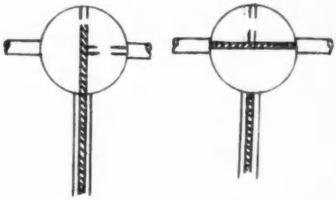
A — Reaction vessel for use with low activity methyl iodide.
B — Methyl iodide vessel.
C — Potassium dispensing unit.
D — Low temperature reflux condenser.
E — Removable refrigerant tube.
F — Liquid ammonia reservoir.
M_1 and M_2 — Mercury manometers (safety valves).
1 — 3-way 3 mm. T stopcock.
2 — Vapor by-pass stopcock.
3 and 4 — Connect system to liquid ammonia reservoir and vacuum line.
5 and 6 — Separate A from B to make diffusion barrier when evacuating system.
7 and 8 — Vacuum line stopcocks.
9 — Magnetic stirrer.

A uniform capillary of 1-2 mm. bore is filled with molten metallic potassium under heptane. This is then standardized according to length and inserted in the side arm of the stopcock, but not into the bore of the stopcock.

The sample to be methylated is placed in reaction vessel A with commercially available distomaceous earth, *Filter-Cel.* The diatomaceous earth gives bulk to the sample, provides a larger reacting surface, and facilitates sampling and handling of the methylated product. About 2 milliliters of ammonia is allowed to reflux into the reaction vessel.

The capillary is then inserted into the stopcock and the length measured. (See figure 2.) The stopcock is then turned to break off the section of capillary and allow the liquid ammonia constantly dripping from the condenser to dissolve the potassium and carry it into the reaction flask. Enough potassium is added, a portion at a time, to keep the mixture light blue, thus insuring an excess of potassium. After five hours the magnetic stirrer is stopped, the ammonia is returned to the reservoir, and the amount of potassium used is calculated. The reaction vessel is warmed and a vacuum used for about 30 minutes to remove all traces of ammonia.

Often reactions (3) and (4) will be faster than (1), resulting in little methylation. Thus all ammonia must be removed.



Position 1 Position 2

FIGURE 2

The potassium dispensing stopcock, labeled 1 in Figure 1, is shown in greater detail. When the cock is in position 1, the tube of potassium may be thrust into it. When the cock is turned to position 2 the end of the potassium is broken off and a predetermined amount of the molten metal is released into the system.

The possible reactions with ammonia present are:

$$(1)\quad -\overset{|}{\underset{|}{C}}-OK + RI \rightarrow -\overset{|}{\underset{|}{C}}-OR + KI$$

$$(2)\quad NH_3 + RI \rightarrow R_1R_2R_3R_4NI + NH_4I$$

$$(3)\quad -\overset{|}{\underset{|}{C}}-OK + R_1R_2R_3HNI \rightarrow -\overset{|}{\underset{|}{C}}-OH + R_1R_2R_3N + KI$$

$$(4)\quad -\overset{|}{\underset{|}{C}}-OK + NH_4I \rightarrow -\overset{|}{\underset{|}{C}}-OH + NH_3 + KI$$

The reactants are frozen with a liquid nitrogen bath, the system evacuated, and the methyl iodide from vessel B is admitted to flask A. The nitrogen bath is removed and the stirrer started. The warmth from the stirrer will cause gentle refluxing of the methyl iodide on the walls of the vessel. Alternate warming and cooling keep the sides of the flask washed down.

This reaction is continued for 18 hours, after which the methyl iodide is returned to flask B, aided by gentle warming of vessel A and the connecting tubes. This completes one cycle, which must be repeated several times for complete methylation.

The product is hydrolyzed with 90% formic acid for 5 hours, and then deionized with ion exchange resins. The residue is then analyzed by descending chromatography with ammoniacal butanol, dried, and sprayed with aniline hydrogen phthalate.

With slight modifications of the reaction flask and use of gas breakseals, ether may be prepared with methyl iodide labeled with carbon-14 or tritium, with minor changes in the process.

It is this technique with which I am working and on which I hope to make some small improvements. I believe that with the appropriate buffers I could apply electrophoresis, rather than the more tedious chromatography. However, because I have not yet completed the assembly of my apparatus, I have no experimental data or conclusions.

I will first learn the technique by working with dextran produced by Leuconostoc Mesenteroides B-512 and sold as a blood plasma expander; later I will attempt to solve the structures of some of the lesser known polysaccharides, the gums.

Lime Crowds Out Red Sorrel

➤ The weeds in your lawn can be crowded out by making grass grow thicker.

A dense, healthy turf is a good defense against sheep sorrel and other weeds, Dr. Felix V. Juska of the U. S. Department of Agriculture, Beltsville, Md., told a Weed Society of America meeting in Denver, Colorado.

Sheep sorrel, a serious lawn and turf weed throughout the Northeast and Midwest during the warm months, grows six to 15 inches high. It has a slender stem with green or red flowers in clusters two to ten inches long. Often called red sorrel, it is difficult to control with herbicides alone.

Working with a thin turf of common Kentucky bluegrass and red fescue heavily infested with sheep sorrel, Dr. Juska found that applying 6,000 pounds of lime per acre, along with fertilizer in the spring and fall of each year, drastically reduced the sorrel.

This was because the resulting dense turf crowded out the weed, he said. The weed will not compete with desirable grasses in soils of high fertility and low acidity.

Irradiated Food

An Army nutrition expert believes that irradiated food may some day be preferred to other foods. He predicts that wholesomeness studies will have proved such food safe in about two years. An Army physician from the Surgeon General's office is not as optimistic. Radioactivity is measurable in food irradiated at large doses. Animal studies are still being made.

by Tove Neville

➤ One Army food expert predicts that people may some day prefer irradiated food to canned or frozen but a doctor in the Surgeon General's Office has "serious doubts as to the ultimate wholesomeness of irradiated food."

These two points of view represent the two basic problems of food irradiation: consumer acceptance and the safety and wholesomeness of such foods. Until these problems are solved, irradiated food will not be served either to the Armed Forces or civilians.

The Army has experimented with irradiated food since 1953. If food could be shipped and stockpiled without refrigeration for use as needed, military supply problems would be greatly simplified. Such food could also be brought to fighting areas lacking refrigeration.

As a result of Congressional interest, the Quartermaster Corps expanded its food irradiation program in 1955 to cover food items for both military and civilian use. This project, lasting until this year, was part of the Atoms for Peace Program.

Irradiated foods are either sterilized or pasteurized by radioactivity. In sterilization, the food is first packed in sealed cans. When thoroughly irradiated, all bacteria in the food are killed, and the food will stay fresh as long as the container lasts and keeps the food from contact with the air.

Food sterilized by radiation is given 4,500,000 to 5,000,000 rads, or 4.5 to 5 mega-rads.

It is not now known how much radiation it takes to sterilize various foods. Tests are continuing to pinpoint the differing doses required for each kind of food. Acidity, density and the food's liquid-solid content help determine the amount of radiation required for sterilization.

The less dense a food, the easier it is sterilized. A liquid is generally more easily sterilized than a solid. To be on the safe side, high doses of radiation are given for sterilization. But taste tests of sterilized food show that the less radiation, the less loss of flavor and change of color and texture.

Therefore, a low-dose method, called pasteurization, has been adopted for many food items that are ordinarily kept only a short time, either in a refrigerator or at room temperature. This method kills only the bacteria on the outside of the food. However, it has increased the "shelf life" of such foods up to ten times.

In experiments, potatoes irradiated at 10,000 rads remained in good condition ten times longer than untreated ones. The treated potatoes were still fresh after 18 months at a temperature of 47 degrees Fahrenheit and had not sprouted, Col. William B. Levin, radiation officer for the Quartermaster General, told Science Service.

Irradiated Oranges

He said that oranges irradiated at 150,000 rads were still fresh after 70 days at 45 degrees Fahrenheit.

Col. Levin said that one difficulty in feeding irradiated food to humans is that after a time they tire of eating foods having unaccustomed tastes. However, sometimes people will become accustomed to eating a certain food in its canned form and actually prefer it to the natural form. He cited tomato juice as an example.

Tastes can change with education. Today the population is generally "educated" to drink pasteurized milk and has come to like and accept its taste. To most persons used to drinking pasteurized milk, the natural product would taste foreign and very likely disagreeable.

The Quartermaster Corps is trying to improve methods of irradiating foods to make them taste like the natural product or like the food people are accustomed to eating.

Irradiated ham and shrimp now taste more like the fresh products than do heat-canned ham and shrimp, Col. Levin said. So also do chicken, pork and bacon.

Irradiating beef, yet retaining its natural flavor, has proved difficult. In early experiments, irradiated beef had a distinct, disagreeable taste and odor. Lately both the taste and smell have been improved.

Irradiated vegetables, like meats, have shown differing results. Many of them, such as carrots and pumpkin, approach their natural look, smell and taste. Others, such as cauliflower, celery and cabbage, are not so successfully irradiated.

Such fruits as peaches and applesauce, when tested after six months, were both quite acceptable in taste and appearance, although the applesauce had turned a little dark, Col. Levin said.

Comparable Price

He estimated that the price of irradiated food would some day be comparable to other preserved foods. Col. Levin believes that wholesomeness studies with animals during the next two years will prove the safety of irradiated food.

But a physician of the U. S. Army Medical Research and Development Command, of the Surgeon General's Office, Col. Lawrence M. Hursh, is not as optimistic. He told Science Service that he doubted whether the wholesomeness of irradiated food would be proved by the time current animal studies end in December, 1963.

The most important problem is that some of the methods used for irradiation at high doses leave measurable radioactivity in the food, Col. Hursh said. Irradiation by linear electron accelerators at 24,000,000 electron volts (Mev) and by fuel rods under water has produced measurable induced radioactivity in foods at levels of several times background radiation.

He said that irradiated food will be accepted for wholesomeness by the Surgeon General Office when the U.

S. Food and Drug Administration accepts it. He believes a cobalt source is the most promising for food irradiation. So far, no radioactivity has been measured in food irradiated by cobalt.

Col. Hursh said that when food is irradiated, the radiation modifies the atoms in the food to form peroxides, carbonyls and aldehydes from fatty acids. These chemicals are toxic at certain levels.

Animals feeding on irradiated food have shown such symptoms as hemorrhages in rats, ruptured hearts in mice and infertility in female dogs.

Adding vitamin K to the diet of the rats cleared up the hemorrhages but Col. Hursh said that more vitamin K was required than laboratory rats are fed in a normal diet.

Mice Tests

Tests with mice on the irradiated diet showed that about 80% developed ruptured hearts. The control animals fed the same but non-irradiated diet did not develop ruptured hearts.

After eating irradiated food, some female dogs showed infertility. Tests with these animals are continuing so as to obtain more conclusive evidence.

Col. Hursh said that enzyme changes had also been observed in animals eating irradiated food. The enzymes are either increased or decreased.

For example, cytochrome oxidase was increased in rat livers from animals fed irradiated beef. This increase can be corrected by adding vitamin K to the diet. The close tie-up between cytochrome oxidase and vitamin K was not known before. Such new knowledge has been an important by-product of the animal studies, Col. Hursh said.

He also said that if irradiated foods were fed in any large amount to humans, the foods would have to be fortified with vitamins of all kinds since irradiation decreases the vitamin content in food.

From July, 1960, the Quartermaster Corps will handle only strictly military items. The Atomic Energy Commission will take responsibility for the program of testing irradiated foods for civilians, mostly low-dose irradiated, or pasteurized, food items.

The Army and the AEC will cooperate and exchange information on their progress.

The Quartermaster Corps will have two radiation facilities. One, a cobalt-60 source of 1 mega-curie being built by the AEC is the largest in the world. The other is an electron source from a linear accelerator of 24,000,000 electron volts now being constructed.

Until the AEC entered the field, research in irradiated foods was done by private research institutes, universities and the Quartermaster Food and Container Institute for the Armed Forces in Chicago.

√ Answers to CHEMISTRY QUIZ on Page 29. √

A - 3; B - 2; C - 4; D - 5; E - 5.

Radiation May Make "Better" Coal

➤ THE POSSIBILITY that atomic radiation could be used to make better bituminous coal for some purposes has been raised by the Bureau of Mines.

Research conducted by the Bureau showed that irradiation (by neutron and gamma-ray bombardment) makes some bituminous coal harder.

It is believed that radiation also disturbs the delicate electrical balance of certain bituminous coal molecules, predisposing the coal to react more readily with other materials.

If true, this could lead to improvements in processes for changing coal to liquid fuels and chemicals.

The research, carried out at Government-owned atomic installations, showed that radiation left most varieties of coal "substantially unchanged." Analyses were made on irradiated samples representing all ranks of bituminous coal, including lignite.

➤ "SHE'S ONE OF *our outstanding scientists — the way she handles the bosses is a science!"*

Stanford Builds Microprobe

➤ One of the rarest scientific instruments — an electron microprobe — has been built at Stanford University. There are scarcely a dozen of them in the country.

Invented several years ago by a Frenchman, the electron microprobe is used for micro-studies of minerals. It pokes a tiny "finger" of electrons, about a thousandth of a millimeter in diameter, at the polished surfaces of metals to be examined.

The microscopic electron beam "feels out" a small portion of the metal, giving an exceedingly fine chemical analysis of it that is accurate to a fraction of one percent. Some of the energy lost by electrons in the beam is transformed into X-rays, which spray out from atoms of the sample in all directions.

When observed with spectrographic equipment, these X-rays show the characteristic X-ray spectrum of whatever element happens to be present in the sample.

The Stanford microprobe was built by Prof. Victor G. Macres with the aid of a grant from the Office of Naval Research. Essentially it consists of a light microscope, an X-ray spectrograph, and the electron source and power supply from an electron microscope. It also includes various special mechanisms, vacuum pumps, and other elements necessary to combine them all into a single instrument.

The electron microprobe may also be used to determine the alignment of crystals in a substance, or even to act as the catalyst in micro-chemical reactions. Used with a cathode ray tube, its tiny "finger" scans the entire sample to produce either a complete electron micrograph (electron microscope photo) or an X-ray micrograph of the object.

Still other potential uses are being explored, which may extend the remarkable instrument's versatility even further.

Electron Furnace Melts Metals

➤ A new industrial furnace has been developed that produces "exceptionally pure" ingots of spaceage materials with a high-powered electron beam.

It tackles with equal vigor the melting, alloying, and refining of such hard-to-handle materials as tantalum, molybdenum, columbium, tungsten, thorium, cobalt, nickel and hafnium. Some of these materials are so active chemically that it is difficult to obtain them in a pure state. Others have extraordinarily high heat resistance and stubbornly resist melting.

Developed by the NRC Equipment Corporation, subsidiary of the National Research Corporation, the new furnace works in principle like a TV picture tube. A high-powered electron gun blasts a target melt area. The electron beam is focused by a magnetic focusing coil. The electron beam bombards a single spot instead of sweeping the melt area. But just as the TV screen has a high voltage applied, so a 20,000-volt attracting force is applied to the stock to be melted. The electron beam attacks this stock with a power of 60,000 watts.

Chemicals Protect Oysters

➤ A NEW CHEMICAL method to keep oysters and clams from being killed by their enemies has been found by three Government scientists.

Heavy oils mixed with sand can be used to surround shellfish beds to control the snails, starfish and, in some cases, crabs that kill oysters and clams. The chemical control method is still in the experimental stage and is not yet recommended for commerical application.

However, the chances are good that the basic principles of the method will solve the age-old problem of protecting shellfish from predators. Some control over shellfish enemies has been needed since oysters and clams were first harvested for food.

Drs. V. L. Loosanoff, C. L. MacKenzie Jr. and L. W. Shearer of the U. S. Fish and Wildlife Service's Biological Laboratory in Milford, Conn., developed the method for chemical control using such heavy oils as orthodichlorobenzene mixed with dry sand or other inert material to hold them in place on shellfish beds.

Effects of the treatment, they found, can be increased by adding other chemicals, such as the insecticide Sevin, to the heavy oils.

The method prevents boring gastropods, starfish, crabs and other enemies of bivalves from invading shellfish beds, and also makes the beds unsuitable for their continued existence.

Ground Water Traced By Fallout

➤ RADIOACTIVE fallout from atom bomb tests can be used to seek out and "expose" new sources of drinking water that lie hidden deep in the earth.

This prospect was suggested by a special report prepared by the Atomic Energy Commission and the U. S. Geological Survey for the Senate Select Committee on National Water Resources.

The report said research projects for developing such techniques are now underway in New Jersey, Wisconsin and New Mexico.

Raindrops have an affinity for absorbing minute particles of tritium from the fallout left in the atmosphere after nuclear bomb tests. Scientists seek ways to use these particles as "atomic dog tags" to identify underground water and find out how it percolates into the earth, where it goes and how fast it travels. This, they believe, may be done by taking samples from test wells at different places and depths from which water "tagged" with tritium can be identified with delicate instruments to learn its origin as rain or snow.

Then, by using harmless quantities of tritium to "tag" water entering the ground at later dates, they hope to be able to measure how fast the water tables are replenished and determine the extent to which they can be dependably put to use.

Much still remains to be learned about the precise location and extent of underground water resources, how they are formed and recharged, their travels, and what can be done to replenish them as they are diminished by use or natural causes.

Macromolecules Studied

➤ LARGE synthetic molecules may give a clue to the structure and operation of living cells.

Synthetic molecules behave in a manner similar to important natural molecules, according to Prof. A. Katchalsky, vice president of the Israel Academy of Sciences and Humanities in Jerusalem.

These large molecules, called macromolecules, are made up of smaller ones strung like beads on a string.

The development of synthetic macromolecules was a real industrial breakthrough and led to the manufacture of plastics, synthetic fibers and synthetic rubber.

Prof. Katchalsky, a physical chemist, said that cell structure, underlying that of all living beings, is also based on special macromolecules.

By studying the behavior of simple synthetic macromolecules, which dissolve in water and have electrical properties, scientists may learn more about the organization of living organisms and the properties of cells.

Prof. Katchalsky and his coworkers discovered that several of their synthetic macromolecules may contract or expand when reacting chemically. This contracting ability of man-made materials illuminates the origin of movement in living beings, including contraction of muscles.

Prof. Katchalsky stressed that the synthetic macromolecules are only models from which to learn the fundamental principles governing the behavior of cells. The ultimate goal of his research is the study of natural macromolecules.

The synthetic macromolecules may possibly help explain the action of certain defense mechanisms of the body. The synthetic macromolecules might act in the body as a new type of drug, and might help fight some blood diseases since certain blood diseases are due to malfunction of natural macromolecules.

Prof. Katchalsky, an official guest at the Royal Society's Tercentenary Celebration in London, said that the Israel Academy of Sciences and Humanities is less than a year old and has been operating for only six months.

Nuclear Blasts May Mine Sulfur

➤ NUCLEAR explosions may be used to mine sulfur in the Gulf of Mexico, a joint meeting of the American Institute of Chemical Engineers and the Instituto Mexicano de Ingenieros Quimicos was told.

John Dales and Roger DeHart of the Southwest Research Institute in San Antonio, Texas, said nuclear mining would be cheaper. The sulfur could be melted by heat from a small nuclear device and then forced up a bore-hole by hot water.

The engineers expect new deposits of sulfur will be discovered under the Gulf of Mexico. They say studies are now being made for recovery of the sulfur by nuclear explosions.

Mr. Dale and Mr. DeHart said that, although the explosion would be entirely contained underground and quite safe, the greatest obstacle to its use would be the lack of understanding on the part of the public.

Call for Fallen "Stars"

➤ A CALL for fallen "stars," meteors that have survived their passage through the earth's atmosphere, has been issued by the Smithsonian Institution, Washington, D. C.

The meteorites are badly needed for a variety of scientific research problems, since these "rocks from space" are the only samples available on earth of extra-terrestrial material.

The Smithsonian has agreed to serve as a central agency for a continent-wide collecting program. It will investigate all reported falls, encourage active search for meteorites, inform interested scientists when new material is available, distribute samples for research and keep accurate records.

Any information concerning recent meteorite falls should be sent to Dr. F. L. Whipple, director of the Smithsonian Institution Astrophysical Observatory, Cambridge, Mass., or E. P. Henderson at the Smithsonian's National Museum in Washington.

It is hoped the new program will increase the number of meteorite falls available for research from one to five or more falls per year.

Lowers Corn's Evaporation

➤ A NEW TECHNIQUE promises to let farmers use less water in growing crops. Scientists have already grown corn with a third less water than required for corn on which the technique was not used.

The scientists from the Illinois State Water Survey and the University of Illinois Department of Botany used a fatty alcohol that forms a film a molecule thick on water surfaces and has been used previously by Water Survey engineers to reduce evaporation from water-supply reservoirs.

In the new work, the scientists introduced the chemical to the roots of the corn plants and found that, with the chemical, the rate of water evaporation from the plants was 17% to 40% lower than for corn grown in untreated soil.

The Water Survey engineer who originated the project, W. J. Roberts, suggests the technique may increase the usefulness of available water in areas where the supply is limited.

The scientists believe the chemical forms a protective film at the openings in the plant from which water evaporates. They plan to use fatty alcohol tagged with radioactive tracers to test this theory.

Isotope Used To X-Ray

➤ MEDICAL radiograms of diagnostic quality comparable to conventional X-rays are being experimentally produced at the General Motors Research Laboratories, Warren, Mich., by a newly developed low-energy, short-lived radioisotope called Samarium-153. The new technique is expected to pave the way for use of X-rays where operation of an X-ray machine would be impossible — in the field, in emergency or disaster situations, and in remote jungle areas. Samarium-153 would supplement conventional X-ray equipment, not supplant it.

Metals Purified By Gas Chromatography

➤ ALLOYS can now be separated into their constituent metallic elements by means of gas chromatography — a technique commonly used in the analysis of gas mixtures.

Dr. Frank E. DeBoer of the Argonne National Laboratory, Lemont, Ill., has used this method to separate the metals in an alloy of zinc and cadmium, two common metals with similar chemical properties, he reported in the British scientific journal, *Nature*.

Chromatography in general works on the principle that, if a solution containing a number of chemicals is allowed to flow through a constricted medium, through blotting paper for example, the different chemicals in the solution will travel at different speeds and may thus be separated. If the chemicals are of different colors, bands of color will be seen in the paper — hence the name.

The same principle is used in gas chromatography, the mixture of gases being diluted with an inert "carrier gas," such as helium, and passed through a long narrow tube. The different fractions are collected.

In this case, helium at 1,150 degrees Fahrenheit was passed over the alloy, which was also at 1,150 degrees, and the metal vapors condensed, after separation, on a cold surface.

This is believed to be the first time that the direct purification of metals in this way has been reported. The work was sponsored by the U. S. Atomic Energy Commission.

Photosynthesis First Step May Be Electronic

➤ NEW EVIDENCE strongly suggests that the first step in photosynthesis, the vital reaction whereby all green plants convert carbon dioxide and water into glucose, may be purely electronic in nature.

Prof. William Arnold and Dr. Roderick K. Clayton, both of the biology division of Oak Ridge National Laboratory in Oak Ridge, Tenn., have studied by spectroscopic methods, the initial changes that take place in the purple bacteria groups when illuminated. They found the change to be the same at temperatures from slightly above room temperature down to nearly absolute zero. At this latter temperature no ordinary chemical changes can take place. Thus the reaction must be electronic, the scientists reason.

Prof. Arnold and Dr. Clayton reported their work in the June Proceedings of the National Academy of Sciences. Prof. Arnold had shown in 1957 that dried chloroplasts (particles containing chlorophyll) act as semiconductors.

The Oak Ridge scientists conclude that "the first step in photosynthesis appears to be the separation of an electron and a hole in a chlorophyll semiconductor."

A hole is a missing electron and behaves, in an electrical field, like a positive charge.

The mechanism of photosynthesis is of great practical importance. It could lead to a direct and efficient method of harnessing the energy of the sun for the use of man.

Book Condensations

An Introduction to Practical Infra-Red Spectroscopy — A. D. Cross — *Butterworths (Canada),* 80 p., paper, $3.50. Standard reference data.

Charting Steel's Progress: A Graphic Facts Book on the Iron and Steel Industry — Introduction by Max D. Howell — *American Iron and Steel Institute,* 65 p., illus., paper, 50¢. Information based largely on the Institute's Annual Statistical Report.

Synthetic Inorganic Chemistry — William L. Jolly — *Prentice Hall,* 196 p., $8. Theoretical and operational text to accompany courses in preparative inorganic chemistry.

Symposium on Air Pollution Control — M. D. Thomas and others — *Am. Soc. for Testing Materials,* 44 p., $1.50. Emphasis is put on the problems of the San Francisco Bay area.

Chemistry and Technology of Fertilizers — Vincent Sauchelli — *Reinhold,* 692 p., illus., $18. Discussion of the raw materials used in chemical fertilizers and their conversion to suitable compounds for the feeding of crop plants.

Perchlorates: Their Properties, Manufacture and Uses — Joseph C. Schumacher — *Reinhold,* 257 p., illus., $8.75. For the research worker.

Cermets — J. R. Tinklepaugh and W. B. Crandall — *Reinhold,* 239 p., illus., $9.50. Discusses physico-chemical aspects of cermets and describes properties, processing, testing and uses of both oxide- and carbide-base cermets.

Cosmetic Science — A. W. Middleton, Ed. — *Butterworths (Canada).* 327 p., illus., $12. Papers and discussions of the First British Congress on Cosmetic Science, London, 1959.

Structure and Change: An Introduction to the Science of Matter — G. S. Christiansen and Paul H. Garrett — *Freaman,* 608 p., illus. by E. L. Gillespie, $8.75. Introduces the student to the scientific view of the physical world, concentrating on the structure of matter.

An Introduction to Chemical Nomenclature — R. S. Cahn — *Butterworths (Canada),* 96 p., paper, $2.25. Describes principles of modern systematic nomenclature and treats both inorganic and organic chemistry.

Crystal Growth: Discussions of the Faraday Society, 1949 — N. F. Mott and others, introd. by W. E. Garner — *Butterworths (Canada),* 366 p., illus., $12. Papers and discussion of nucleation and normal crystal growth, abnormal and modified growth, and technical aspects of mineral synthesis.

A Statistical Manual for Chemists — Edward L. Bauer — *Academic,* 156 p., $4.75. For chemists who perform experiments, make measurements, and interpret data.

Chemical Technology of Petroleum — William A. Gruse and Donald R. Stevens — *McGraw,* 3rd ed., 675 p., $15. Covers the chemistry of petroleum and modern methods, standards and practices of petroleum distillation and refining.

Chemistry Comments

➤ A rem (roentgen equivalent man) is a radiation dose of any ionizing radiation estimated to produce a biological effect equivalent to that produced by one roentgen of X-rays.

➤ Lead is heavier than 81 other elements, or roughly, 80% of the periodic table.

➤ Through electron microscopy, microphotographs can be made of metallic structures magnified upwards of 25,000 times their original size.

➤ Benzoic acid is used in preservatives, plasticizers and resins.

➤ About 14 billion gallons of liquid petroleum are annually produced in the U. S. from natural gas.

➤ Monosodium glutamate, a food-flavor enhancer, is a by-product of the beet-sugar and cereal-milling industries in the U. S.

➤ The earliest examples of man-made iron objects are beads of meteoric iron, shaped by hand-rubbing and worn in Egypt about 6,000 years ago.

➤ All drugs are toxic when used in excessive amounts.

➤ World production of aluminum during 1959 was about 4,400,000 tons, about 12% above 1958 output.

➤ Milk is nature's most perfect food in providing the nutrients needed for good health.

➤ The United States' fresh water supply needs will exceed the natural supply by 85 billion gallons a day within 20 years.

➤ Sixty million pages of scientific reports will be published in the technical journals of the world during 1960 it is estimated.

➤ Only 10% of the nicotine entering the body is absorbed if smokers do not inhale, but 90% is absorbed if they do.

➤ Fabrics to be used for re-entry parachutes in manned satellites may be woven from fine wire composed of nickel-chromium and cobalt-chromium alloys.

➤ The first completely new method of using wood to be developed since the time of Julius Caesar was the wholesale manufacture of plywood.

➤ The degrees conferred in certain scientific subjects by 140 selected American Universities will henceforth be recognized by the Malayan Government.

➤ A plasma consists of positively and negatively charged particles.

➤ Glass fiber and a new silicone adhesive team to produce a new shatterproof electric light bulb with a service life of about 2,500 hours.

➤ Nearly 1.3 billion pounds of plastic materials (including coatings and bonding materials) were consumed by the building industry in 1959, or 23% of the total United States plastic consumption.

➤ A new bacteria-fighting polyethylene, especially effective as a killer of the disease-producing organisms, is now being marketed.

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